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MHKKG/SUN
P.O. BOX 398
AUSTIN, TX 78767

EXAMINER	
PATEL, KAUSHIKKUMAR M	

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/821,371
Filing Date: April 09, 2004
Appellant(s): LANDIN ET AL.

Stephan J. Curran
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed June 23, 2008 appealing from the Office action mailed February 05, 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2004/0034747	Rowlands et al.	2-2004
6,948,035	Rowlands et al.	9-2005
6,931,496	Chen et al.	8-2005
5,940,860	Hagersten et al.	8-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 7-15 and 18-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rowlands et al. (US 6,948,035) (Rowlands-1), Rowlands et al. (US 2004/0034747) (Rowlands-2) and Chen et al. (US 6,931,496).

As per claims 7, 18 and 22, Rowlands-1 teaches a multi-node system, (figs. 1-3), comprising:

A node including a plurality of active devices and an interface coupled by an address network configured to convey address packets between the interface and the plurality of active devices and a data network configured to convey data packets between the interface and plurality of active devices, wherein the address network and the data network are separate networks (Rowlands-1, fig. 1, items 12A – 12N, col. 12, lines 19-25, col. 8, lines 3-13, it is noted here that Rowlands-1 discusses sending receiving packets throughout the disclosure and he also teaches use of separate address and data bus which can be interpreted as address and data networks);

an inter-node network configured to convey coherency messages between the interface in the node and an additional interface in an additional node (Rowlands-1, fig. 1, fig. 2, col. 8, lines 65-67, col. 9, lines 25-47, col. 10, lines 53-65), wherein the additional interface is configured to send a coherency message requesting a read access right to a coherency unit on the inter-node network (Rowlands-1, col. 3, lines 15-67, col. 5, lines 53-55, col. 9, lines 3-46), wherein a given active device of the plurality of active devices has an ownership responsibility for the coherency unit (Rowlands-1, col. 10, lines 40-47, the agent with exclusive ownership);

wherein the interface is configured to respond to the coherency message by sending a proxy address packet on the address network (Rowlands-1, col. 10, lines 6-35, col. 19, lines 24-33, probe commands);

wherein a different active device of the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network (Rowlands-1 does not explicitly describe this, but the system of Rowlands-1 as described in figs. 1-3, with multiple nodes with multiple active devices (i.e. processors, memory and I/O bridge (agents)) communicates with each other and share data to each other inherently requires any active device in any node can be capable requesting a read access right to any coherency unit, Rowlands-1, col. 10, line 53 – col. 11, line 9, illustrates one example).

Rowlands-1 fails to explicitly teach given active device with ownership responsibility of the coherency unit and another coherency unit (i.e. two different units) and another active device from same node is requesting read access to one of the coherency unit and a different active device from another (remote) node requests second of the coherency unit, but the system with multiple node (such as of Rowlands-1's system) including plurality of active devices in each node can own multiple coherency units and any of the active device can request read access to any coherency units thus satisfying the limitations, given active device with ownership responsibility and read access request for coherency units. However, Rowlands-1 fails to teach transitioning ownership, when active device from remote node requests a read access right to coherency unit. Rowlands-2, teaches two-tiers of coherency mechanism in multi-node system (Rowlands-2, par. [0022], intra-node as MESI protocols and inter-node as MSI protocols), and further teaches that a remote node can acquire cache line (coherency unit) in shared state or in modified state (i.e. exclusive ownership) and in

modified state the node can give an exclusive ownership to a single agent (Rowlands-2, pars. [0069] – [0071]). As per well-known MSI (i.e. modified, shared, invalid) protocols, when data requires in shared state, the active device (or node) with modified state (i.e. exclusive ownership) must write back data to memory and transition to shared state, this satisfies the limitation, "when active device from another node requests read access to coherency unit from owner (agent within the node with inter-node state as modified state), the owner (agent or active device), owning device writes back the cache line and transitions state (global state) from modified to shared and hence the ownership of the coherency unit". It would have been obvious to one having ordinary skill in the art at the time of the invention to utilize two-tier coherency protocol as taught by Rowlands-2 in the system of Rowlands-1 to reduce the bandwidth requirement of the system (Rowlands-2, par. [0025]). Rowlands-1 and Rowlands-2 however combined fail to teach not transitioning ownership for intra-node active device read request. Chen teaches sharing modified cache line within the node, i.e. active device with modified cache line (exclusive owner of the line) can share the line to other active device within the node (Chen, col. 3, lines 54-67). It would have been obvious to one having ordinary skill in the art at the time of the invention to utilize teaching of Chen in the system of Rowlands-1 and Rowlands-2, because by sharing modified data without gaining exclusive ownership of data reduces network traffic (Chen, col. 2, lines 52-63).

As per claims 8-9 and 23-24, Rowlands-1 and Rowlands-2 teach a multi-node system with plurality of active devices (Rowlands-1, figs. 1-3, Rowlands-2, figs. 8-11) and interfaces are able send and receive address packets (Rowlands-1, col. 8, lines 65-

67, col. 9, lines 25-47, col. 10, lines 53-65, Rowlands-2, par. [0072]), which inherently teaches active devices within the inter-node system request access rights (read/write) to any coherency unit from any other active device in any node, and subsequently send address packets, thus satisfying limitations of claims.

As per claims 10-13, 19-20 and 25-28 Rowlands-1 and Rowlands-2 teach multi-node system as explained with respect to claims 7-9 above, wherein when a device requests read access right to cache line, the owner sends data to requester and memory bridge (Rowlands-1, col. 7, lines 30-35) issues a probe commands (proxy) or node controller (Rowlands-2, par. [0072]) issues probe commands (proxy) to gain ownership, thus the requester gains the read access right at the end of the transaction and sending address packets is inherent in the system.

As per claims 14, 21 and 29, Rowlands-1 teaches exemplary RdShd and cRdShd commands (Rowlands-1, col. 19, 24-35), which is equivalent to read-to-share and proxy-read-to-share commands.

As per claim 15, Rowlands-2 teaches two-tier coherency as explained with respect to claim 7 above and further teaches that the ownership is maintained according to both protocols in combination (Rowlands-2, pars. [0068] – [0069]). Rowlands-2 also teaches that when node borrows cache line in shared state (i.e. inter-node shared), no modification is allowed (i.e. no exclusive ownership), which inherently means, when the inter-node global state is shared, no node has exclusive ownership of the cache line.

3. Claims 16-17 are rejected under **35 U.S.C. 103(a)** as being unpatentable over Rowlands et al. (US 6,948,035) (Rowlands-1), Rowlands et al. (US 2004/0034747) (Rowlands-2) and Chen et al. (US 6,931,496) as applied to claim 7 above, and further in view of Hagersten et al. (US 5,940,860).

As per claim 16, Rowlands-1, Rowlands-2 and Chen combined fail to teach the limitation of claims 16-17, but Hagersten teaches when global state of node is modified (i.e. gM), internal bus entity (active device) has an exclusive copy of the cache line (Hagersten, col. 11, lines 1-2) and there can be no valid copy of same memory block existing anywhere in the system (Hagersten, col. 7, lines 34-40). It would have been obvious to one having ordinary skill in the art at the time of the invention to utilize teaching of Hagersten in the system of Rowlands-1, Rowlands-2 and Chen to maintain efficient coherency of the system.

Claim 17 is rejected under same rationales as applied to claim 15 above.

(10) Response to Argument

Appellant argues:

Rowlands-1 is merely disclosing that the memory bridge 32 can request, via coherency commands (probes), ownership from other nodes and the probes referred to by the Examiner are sent out of the node to other nodes and not within the node to the processors (Appeal Brief, page 12, second paragraph).

Examiner response:

According to well known meaning in the art, probes are the commands that are generated in response to the commands received by the device, and as admitted by the Appellant the memory bridge 31 requests the ownership from the other nodes using probe commands and again as admitted by the Appellant and as taught by the Rowlands-1 (col. 5, lines 44-62) "the memory bridge 32 may issue one or more coherency commands to the other nodes to obtain the ownership (and copy of the cache block, in some cases). Similarly, if the transaction accesses a local cache block but one or more other nodes have a copy of the cache block, the memory bridge 32 may issue coherency commands to the other nodes". Here it is entirely evident that the memory bridge of the requesting node sends the coherency command and not the probe command as Appellant argues. Further, Rowlands-1 teaches "Still further, the memory bridge 32 may receive coherency commands from the other nodes, and may perform transactions on the interconnect 22 to effect the coherency commands". Here it is evident that the memory bridge 32 internally performs the transaction, and it is apparently clear to one of ordinary skill in the art that to perform a transaction a command is necessary and that command is a probe command (issued in response to coherency command received from the other node). This is evident from col. 6, lines 15-28 of Rowlands-1, which states: "The memory bridge 32 in the remote node may generate and transmit the coherency command to the home node to obtain the copy or to obtain sufficient ownership. The memory bridge 32 in the home node may determine if any state changes in the other nodes are to be performed to grant the requested ownership to the remote node, and may transmit coherency commands (e.g. probe

commands) to effect the state changes". Here it evident that when the node receives the coherency command from the other node, it sends probe command (or proxy command) to effect the state changes (which also includes the active devices in the home node as well as the devices in the remote nodes) and/or to send data to the requester. Thus, it is clear that the memory bridge of the Rowlands-1 does send the proxy command on the interconnect to effect the transactions.

Appellant further argues: neither Rowlands-2 nor Chen is relied upon, nor do they teach or suggest the above limitations. Thus, Appellant submits none of the cited references teach or suggest the limitations of the claim 7 (Appeal Brief, page 12, last paragraph). Since, Appellant is relying on Rowlands-1 not teaching memory bridge that sends proxy address packets on the interconnect, claim 7 is patentable, however as explained above, Rowlands-1 does teach the limitation and accordingly the rejection of the claim 7 should be sustained.

Appellants arguments with regards to the rejection of claims 14, 21 and 29 are also related to the memory bridge not sending probe commands and accordingly Appellant argues that the claims are patentable, however as explained above, the memory bridge does issue the probe commands internally, accordingly the rejection of the claims 14, 21 and 29 should also be sustained.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Kaushik Patel

/Kaushik Patel/

Examiner, AU 2188.

Conferees:

/Vincent F. Boccio/

Primary Examiner, Art Unit 2169

Appeal Specialist TC2100

/Hyung S. Sough/

Supervisory Patent Examiner, Art Unit 2188

09/12/08